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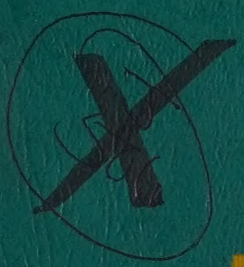
INSTRUCTIONS



for the

MODEL 981

TYPE 3A

TUBECHECKER

THE WORLD LEADER IN
WESTON
MEASUREMENT AND CONTROL

INSTRUCTIONS

FOR THE

WESTON MODEL 981 TYPE 3A TUBECHECKER

(Patents Pending)

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DESCRIPTION

GENERAL: The Weston Model 981 Type 3A tubechecker is a new, functional tubechecker of the Proportional Mutual Conductance Type, employing filtered d-c plate, screen grid and control grid voltages. The instrument consists of a vacuum tube and a voltage regulator tester mounted as one complete assembly in a welded steel case. One of the outstanding features of this instrument is the switching system utilized in connecting the various tube elements to their proper potentials. This means connecting a screen grid through the proper resistance to a suitable supply; by testing twin section tubes having identical sections as completely separate units, etc. This is accomplished by using nine single-circuit 12 position rotary switches. Due to the number of switches and positions per switch, protection against early obsolescence is insured.

POWER REQUIREMENTS: 100-125 volts, 60 cycles, single phase alternating current, 30 watts.

RANGES:

1. G_m: A basic scale of 0-3000 micromhos is provided and is multiplied by a factor given in the REMARKS column of the roll chart for determining actual tube G_m. Tubes having a G_m as high as 24,000 can be measured with the same accuracy using only one basic scale.

2. LEAKAGE RESISTANCE: 0-10 Megohms with an accuracy of $\pm 10\%$ at 250K mark.

3. VOLTAGE REGULATOR TEST: 0-200 volts d-c with an accuracy of $\pm 2\%$ at full scale.

CONTROLS: The meter mounted on the panel contains all the scales necessary to test grid tubes, VR tubes, low-power thyratrons, diodes, rectifiers and magic eye tubes. The 0-3000 micromhos is the basic G_m scale. Just below the G_m scale is the voltage regulator scale reading from 0-200 volts d-c. An ohms scale reading up to 10 megohms is also provided. Scale marks are provided to indicate the condition of diodes and rectifiers.

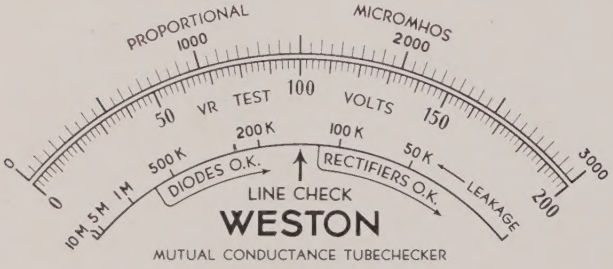


Fig. 1—Actual Size Scale—Model 981 Type 3A

Near the upper left hand corner of the panel is the filament voltage switch marked FILAMENT VOLTS. On the roll chart under FIL is the correct setting of this switch for each tube type. A constant current supply of 600 milliamperes is available for the testing of series string TV tubes. This supply is connected between the 2.5 and 3.3 volt positions on the filament transformer, and is marked 0.6a. Series string tube types are listed on the roll chart with a FIL setting of 0.6a.

Directly below the filament voltage switch is the GRID BIAS control. When testing amplifier tubes this control should be set for the correct bias as specified on the roll chart under the column marked BIAS.

To the left of the GRID BIAS control is the L-H BIAS switch which when in the up or L position selects a low range of bias voltage and a high range of bias voltage in the H position.

The nine switches marked SELECTORS directly below the meter are used to connect the various tube pins to the testing circuits. To correctly index these switches it is necessary to refer the column marked SEL on the roll chart. For example, for an 0A2 tube, the SELECTOR settings are 310KP-0000. The first 5 numbers correspond to the settings of the top row of 5 switches reading from left to right, and the last four numbers correspond to the settings of the bottom 4 switches always reading from left to right.

To the right of the SELECTOR switches is the METER SENSITIVITY control which controls the sensitivity of the meter circuit. Its proper setting for any tube type is found on the roll chart under the column marked SENS.

Just above the METER SENSITIVITY control is the SIGNAL switch. This switch is used to select the appropriate value of 5000 cycle signal voltage applied to the grid of the tube under test. Its setting is specified in the SIG column of the roll chart.

Directly below the fuse post on the left hand edge of panel is the ON-OFF toggle switch.

To the right of the ON-OFF switch is the LEAKAGE TEST which in its numbered positions disconnects all of the tube elements from the G_m test circuit and connects them into the leakage test circuit.

Directly in a line and to the right of the LEAKAGE TEST switch are three toggle switches marked K_1-K_2, P_1-P_2 and G_1-G_2.

These switches enable the operator to check individually the other sections of twin-section tubes with only one set of SELECTOR settings Unless otherwise specified in the REMARKS column of the roll chart, these switches must always be in the K_1, P_1 and G_1 positions.

The switch located to the right of the G_1-G_2 toggle switch is used for selecting the appropriate value of plate voltage and is marked PLATE VOLTAGE (Ep). This switch should be set to the position specified under the Ep column on the roll chart.

To the right of the PLATE VOLTAGE (Ep) switch are three spring-return toggle switches in their normal up position. The switch marked LINE CHECK is used to change the meter to an a-c voltmeter and connect it in the line check circuit so that corrections can be made for variations in line voltage. This switch is used in conjunction with the LINE CONTROL potentiometer in the lower right-hand corner of the panel.

The toggle switch next to the LINE CHECK switch marked AMPL-RECT & DIODES is used for testing amplifier tubes in the up position, and rectifiers or diodes in the down position. Since this switch is of the spring-return type and is normally in the up or AMPL position, it is necessary that it be held in the down or RECT & DIODES position when testing rectifiers or diodes.

The extreme right-hand toggle switch is the Gm TEST switch normally in the off position. This switch must be held down when testing amplifier tubes. When held in the down position, the 5000 cycle test signal is applied to the grid of the tube under test.

Just above the meter is a red PLATE cap and a black GRID cap to be used when called for in the REMARKS column of the roll chart. Mounted near the acorn tube socket is a small black plate cap used for making connection to the wire plate lead of certain acorn tube types.

A complete set of data for testing tubes with the Model 981-3A is provided in the form of a roll chart mounted near the bottom edge of the panel. The roll chart is protected by a transparent cover which has two red reference lines for easy readability.

ROLL CHART ABBREVIATIONS:

TYPE —Lists the tube according to the RMA number.

FIL —Setting of the FILAMENT VOLTS switch.

SIG —Setting of the SIGNAL switch.

NOTE: The scale reading is NOT multiplied by the setting of this switch. When a "D" or "R" appears in the SIG column, it indicates a Diode or Rectifier tube is being tested, and the SIG switch is not in the circuit.

BIAS —Setting of the GRID BIAS control and the L-H BIAS switch.

Example: A setting of 20L means that the GRID BIAS control is set to 20 and the L-H BIAS switch is set to the "L" position.

SEL —Settings of each of the nine SELECTOR switches.

SENS —Setting of the METER SENSITIVITY control.

Ep —Setting of the PLATE VOLTAGE (E.) switch.

REJ. PT. —Value of the meter reading at which the tube being tested should be rejected.

REMARKS—Any pertinent information as to testing of the tube which may include any of the following abbreviations:

F—Meter will indicate short when LEAKAGE TEST switch is in position 1.

No leak check—Do not rotate LEAKAGE TEST switch through positions 1, 2, 3, 4, or 5.

Leak on—A short circuit will be indicated on meter for the positions of the LEAKAGE TEST switch following this abbreviation.

Pe—Pentode section of tube is being tested.

Tr—Triode section of tube is being tested.

P_1 & P_2—Tubes shall be tested with toggle switch marked P_1-P_2 in both P_1 and P_2 positions.

G_1 & G_2—Tubes shall be tested with toggle switch marked G_1-G_2 in both G_1 and G_2 positions.

K_1 & K_2—Tubes shall be tested with toggle switch marked K_1-K_2 in both K_1 and K_2 positions.

NOTE: When the "2" position of more than one of the K, P or G toggle switches is specified, it is desirable to throw these switches simultaneously to avoid overloading the tube under test. Unless otherwise specified, these toggle switches must be kept in the K_1, P_1, G_1 position.

Osc—Oscillator section of tube is being tested.

Whole Tube—Specifies that all elements in tube are being tested simultaneously.

Reg—Shows how many volts voltage regulator tubes can vary on the "VR TEST VOLTS" scale.

Firing Lim—The range of voltage following this abbreviation indicates the firing limits of the tube under test.

Plate cap—Plate cap should be connected to tube cap.

Grid cap—Grid cap should be connected to tube cap.

Thyra—Thyratron.

X1, X2, X3, etc.—In the remarks column indicates the factor used to multiply the scale reading to obtain the actual G_m value.

NOTE

The reject points listed on the roll chart are given in terms of the basic 0-3000 micromhos scale. If a tube reads below the reject value it should be considered faulty. However, it is possible in certain special applications that a tube must be replaced before the given reject point has been reached. Conversely, other tubes may function satisfactorily if their G_m has dropped as low as 50% of their nominal or bogie values. In accordance with RTMA standards, 65% of a tubes nominal G_m has been established as the rejection point. The multiplying factor in the REMARKS column is used only to obtain the actual G_m, and is accomplished by multiplying the reading on the 0-3000 micromhos scale by the multiplying factor. This factor is not used with the reject point.

The additional abbreviations that may appear in the SIG column are:

R—Tube is to be tested as a rectifier.

D—Tube is to be tested as a diode.

VR—Voltage regulator tube.

E—Test procedure for tuning eye tubes is to be used.

OPERATING INSTRUCTIONS

OPERATION: To operate the Model 981-3A the following procedure should be followed:

1. Place tubechecker on a flat solid surface and plug line cord into 100-125 volt, 60 cycle a-c source.

2. Turn ON-OFF switch to the ON position.

3. With the LINE CONTROL in the mid-position the PILOT light should glow at a normal brilliance.

4. The tubechecker is now ready for operation.

LEAKAGE TEST: Leakage testing is controlled by the LEAKAGE TEST switch, which in its numbered positions disconnects all of the tube elements from the other testing circuits and connects them into the leakage test circuit. The meter deflection in each switch position is indicative of the resistance between the isolated element and all other elements of the tube. For this circuit the meter deflection is inversely proportional to the leakage resistance, a full-scale reading indicates zero resistance as marked on the meter scale. Resistances as high as 10 megohms can be measured. The element checked for any position of the LEAKAGE TEST switch is as shown below:

Leakage Test switch position	*Measures leakage between*
1	Heater and Cathode
2	Suppressor grid and all other elements
3	Plate and all other elements
4	Screen grid and all other elements
5	Control grid and all other elements

A low or zero resistance indication for position 1 is normal for tubes that are of the filamentary type or have an internal heater-cathode connection.

The red line on the leakage scale is the 250,000 ohms mark and is the approximate value that causes the neon lamp to light in conventional short test circuits. A leakage indication may be normal if listed in the REMARKS column.

GM TEST:

1. Refer to roll chart for data on tube to be tested.

2. Turn FIL, SIG, BIAS, SEL, SENS and Ep to given settings.

3. Set LEAKAGE TEST switch to position 1 and insert tube into proper socket.

4. Turn tubetester on and allow tube to warm up.

5. Pull down LINE CHECK switch and adjust meter pointer to red arrow by means of the LINE CONTROL.

6. Rotate LEAKAGE TEST switch through positions 1, 2, 3, 4 and 5, tapping tube lightly for each position of the switch. If meter indicates less than 500K ohms the tube should be rejected. In certain critical applications, such as audio pre-amplifier stages or certain TV circuits, the heater-cathode and/or interelement leakages cannot be less than 2 megohms.

7. With LEAKAGE TEST switch in the TUBE TEST position, depress G_m TEST switch for G_m reading. If meter indicates less than the value given in the REJ. PT. column, the tube should be rejected as bad.

DIODE & RECTIFIER TUBES:

1. Refer to roll chart for data on tube to be tested.

2. Turn FIL, SEL, SENS and Ep to given settings. (The SIG and BIAS settings have no effect when testing rectifiers or diodes).

3. Set LEAKAGE TEST switch to position 1 and insert tube into proper socket.

4. Turn tubetester on and allow tube to warm up.

5. Pull down LINE CHECK switch and adjust meter pointer to red arrow by means of the LINE CONTROL.

6. Rotate LEAKAGE TEST switch through positions 1, 2, 3, 4 and 5, tapping tube lightly for each position of the switch. If meter indicates less than 500K ohms the tube should be rejected. In certain critical applications, the heater-cathode and/or interelement leakages cannot be less than 2 megohms. A low or zero resistance indication for position 1 is normal for tubes that are of the filamentary type or have an internal heater-cathode connection.

7. With LEAKAGE TEST switch in the TUBE TEST position, depress the AMPL.-RECT & DIODES switch to the RECT & DIODES position.

NOTE

If a D appears in the SIG column of the tube data, the meter must read above the DIODES OK mark. If an R appears in the SIG column of the tube data, the meter must read above the RECTIFIERS OK mark.

VOLTAGE REGULATOR (VR) TUBES:

1. Refer to roll chart for data on tube to be tested.

2. Set FIL, SEL and Ep to given settings. The VR in the SIG column indicates that the procedure for testing Voltage Regulator tubes is to be used.

3. Turn LINE CONTROL fully counterclockwise and insert tube in socket.

4. Turn tubetester on but do not make a line check.

5. Turn LINE CONTROL slowly clockwise, observing the point on the 200 volt test scale at which the tube fires. When the tube has fired the pointer will fall back to a lower value of voltage. The value of voltage at which the pointer falls down-scale should be within the firing limits as specified on the roll chart. If the tube has a flickering glow, or the meter is variable, advance the LINE CONTROL until both are steady. Observe this reading.

6. Leaving the LINE CONTROL set as is, vary the FILAMENT VOLTS switch through the positions stated and again observe the meter reading. This new reading should not vary more than the value of "V Reg" as stated in the REMARKS column.

PRECAUTIONS IN TESTING VOLTAGE REGULATOR (VR) TUBES:

1. Do not insert tube in socket until all controls to be used have been properly set.

2. Do not make a leakage test.

3. Do not change any of the SELECTORS while tube is in socket.

4. Do not rotate LINE CONTROL after tube has properly fired.

NOTE

Failure to heed above comments may result in a test that is meaningless.

LOW-POWER THYRATRON TUBES:

1. Refer to roll chart for data on tube to be tested.
2. Adjust FIL, BIAS, SEL, SENS, and Ep to proper settings.
3. Rotate GRID BIAS control to 45 and insert tube into proper socket.
4. Turn tubetester on and make line check.
5. Depress AMPL.-RECT & DIODE switch to RECT & DIODE position.
6. Slowly rotate the GRID BIAS control down to zero observing the value of GRID BIAS setting at which the meter suddenly deflects up-scale. This is a test of the tubes control grid characteristic and the value of GRID BIAS setting should fall between the limits given on the REMARKS column. For example, a tube having "Fire 10-0 bias" in the REMARKS column should fire for a value of bias between 10 and 0.
7. With the AMPL.-RECT & DIODES switch in the RECT & DIODE position, the meter pointer must fall in the RECTIFIERS OK position of the scale to be considered good.

MAGIC EYE TUBES:

1. Refer to roll chart for data on tube to be tested.
2. Adjust FIL, BIAS, SEL and Ep to proper settings.
3. Make leakage test.
4. Vary GRID BIAS control and observe if shadow on the magic eye changes.

THEORY OF OPERATION

Gm TESTS: Of the many measurable characteristics of vacuum tubes, mutual conductance is the one most closely associated with actual operating performance. This is the method used for testing grid tubes in the Weston Model 981-3A tubetester. This test is performed in the following manner:

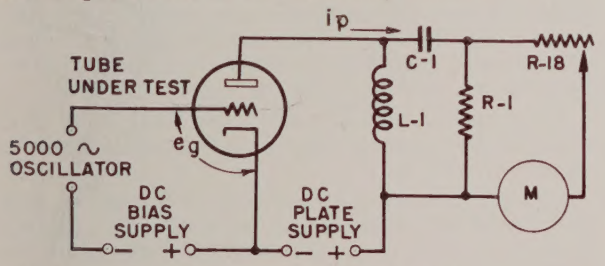


Fig. 2—Basic Gm Test Circuit

All element voltages on the tube being tested are filtered d-c potentials which gives a more accurate and indicative test. The plate circuit consists of the variable d-c plate supply and a high-pass filter consisting of L-1, C-1 and R-1 which is connected to the meter circuit consisting of R-18 and the meter M. This filter passes only the 5000 cycle component of plate current and blocks the d-c plate current and any 60 cycle ripple that may be present.

The grid circuit consists of the variable d-c bias supply and a 5000 cycle oscillator. When a signal voltage eg is impressed on the grid of the tube under test, a signal current ip is produced in the plate circuit which produces a meter reading proportional to the value of grid signal and gm of the tube. For a given signal eg, the meter can then be calibrated to read in terms of gm using the following relationship.

$$ip = eg \times gm$$

where gm is the Mutual Conductance, then;

$$gm = \frac{ip}{eg}$$

therefore, if the grid signal eg is 1 volt and the plate current ip is 3 milliamperes, a full scale deflection on the meter corresponds to 3000 micromhos.

$$gm = \frac{0.003}{1} = 0.003 \text{ mhos}$$

Since 1 mho = 1,000,000 micromhos, then 0.003 mhos = 0.003 × 1,000,000 = 3000 mircromhos.

The term proportional mutual conductance is derived from the fact that proportional values of element voltages are applied to the tube under test.

When it is desirable to determine the true G_m of a tube, multiply the meter reading by the correction factor (X1-X2-X3, etc.) in the remarks column. This corrected reading now refers to the G_m of the tube using its typical Class A_1 operating conditions.

Do not confuse the correction factor with the rejection point listed on the roll chart. Read note on page 3 to further clarify.

DIODE & RECTIFIER TESTS: The useful life of a diode or rectifier type tube ends when its ability to emit electrons falls below some given level, the exact value of which may differ for each type. The basic circuit used is shown below:

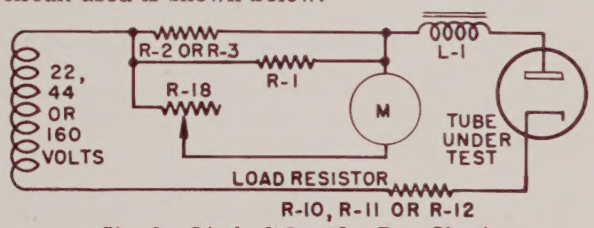


Fig. 3—Diode & Rectifier Test Circuit

A milliammeter is connected in series with the tube under test to measure the tube current and is protected by the meter measuring network. For a given tube type, a suitable plate voltage and load resistor is chosen and applied to the tube under test. Each rectifier and diode type is rated in terms of emissive capacity and must read above the appropriate scale marking to be considered good.

VOLTAGE REGULATOR (VR) TESTS: The testing of volt-

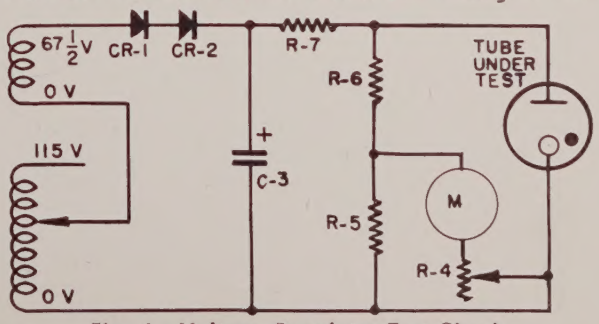


Fig. 4—Voltage Regulator Test Circuit

age regulator tubes is accomplished through the use of a separate variable d-c power supply contained in the Model 981-3A.

A variable d-c supply voltage is obtained through the use of a fixed and a tapped a-c source, two selenium rectifiers CR-1 and CR-2 and a charging capacitor C-3. D-C potentials are applied to the voltage regulator tube under test through a current limiting resistor R-7 which also serves as the regulating resistor. A voltmeter circuit consisting of R-4, R-5, R-6 and the meter M indicates the firing voltage as the applied potential is increased over the range in which the tube should fire. The point at which the tube fires is indicated by a sudden downward deflection of the meter pointer. This occurs because it is the property of a voltage regulator tube to maintain a voltage across its elements in the order of five to ten volts below its firing potential.

After a VR tube has fired, its value as a regulator can be determined by increasing the applied voltage between the limits specified on the roll chart. Between these limits a variation from the regulating point will be an indication of the tube's regulating capacity. If, for example, a tube fires at 110 volts, let us assume that it will maintain a regulating potential of approximately 105 volts, with the following in the REMARKS column: "4.0V Reg, Fil 5 to 70V". Therefore, when the FILAMENT VOLTS switch is rotated from 5 to 70, the meter which now acts as a voltmeter across the VR Tube, should not vary more than 4 volts. If the variation is more, then the VR tube should be considered as faulty and should be replaced.

LOW POWER THYRATRON TESTS: Low Power Thyratron Tubes are tested in the Model 981-3A for both their grid characteristics and their conduction capabilities. The tube to be tested is connected in the test circuit as shown below:

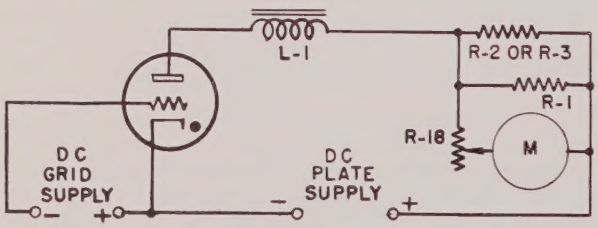


Fig. 5—Thyratron Test Circuit

In this test the tubetester meter is connected in the plate circuit as a milliammeter. The tube is held to cut-off by means of a high bias applied to the tube. When the bias is decreased so that the grid becomes less negative with respect to the cathode, a point will be reached when the tube will suddenly conduct and give an indication on the meter. The value of GRID BIAS setting at which this occurs should fall within the limits as specified in the REMARKS column of the roll chart. For example, a tube having "Thyra; Fire 15-0 bias" in the REMARKS column should fire between a GRID BIAS setting of 15 and 0.

After the tube has fired the pointer should fall within the specified portion of the scale to be considered good.

LEAKAGE TEST: The leakage tests are performed at a d-c potential of 125 volts. For each numbered position of the LEAKAGE TEST switch, a specific tube element is isolated and connected into a series ohmmeter circuit consisting of the isolated element, the 125 volt d-c potential, a current limiting resistor, a milliammeter, and all other elements of the tube.

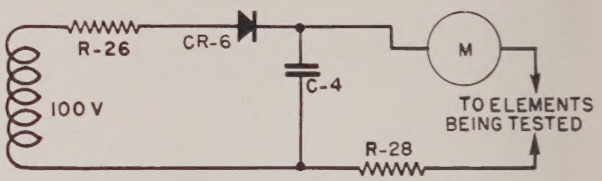


Fig. 6—Leakage Test Circuit

The d-c supply is composed of R-26, CR-6, and C-4. Resistor R-28 is a current limiting resistor which also determines the center scale value of the ohmmeter.

MAINTENANCE

FUSE: One standard 3AG 2 amp fuse is used in the fuse port located above the ON-OFF switch.

LAMPS: One #47 bayonet type pilot bulb is used in the PILOT lamp circuit.

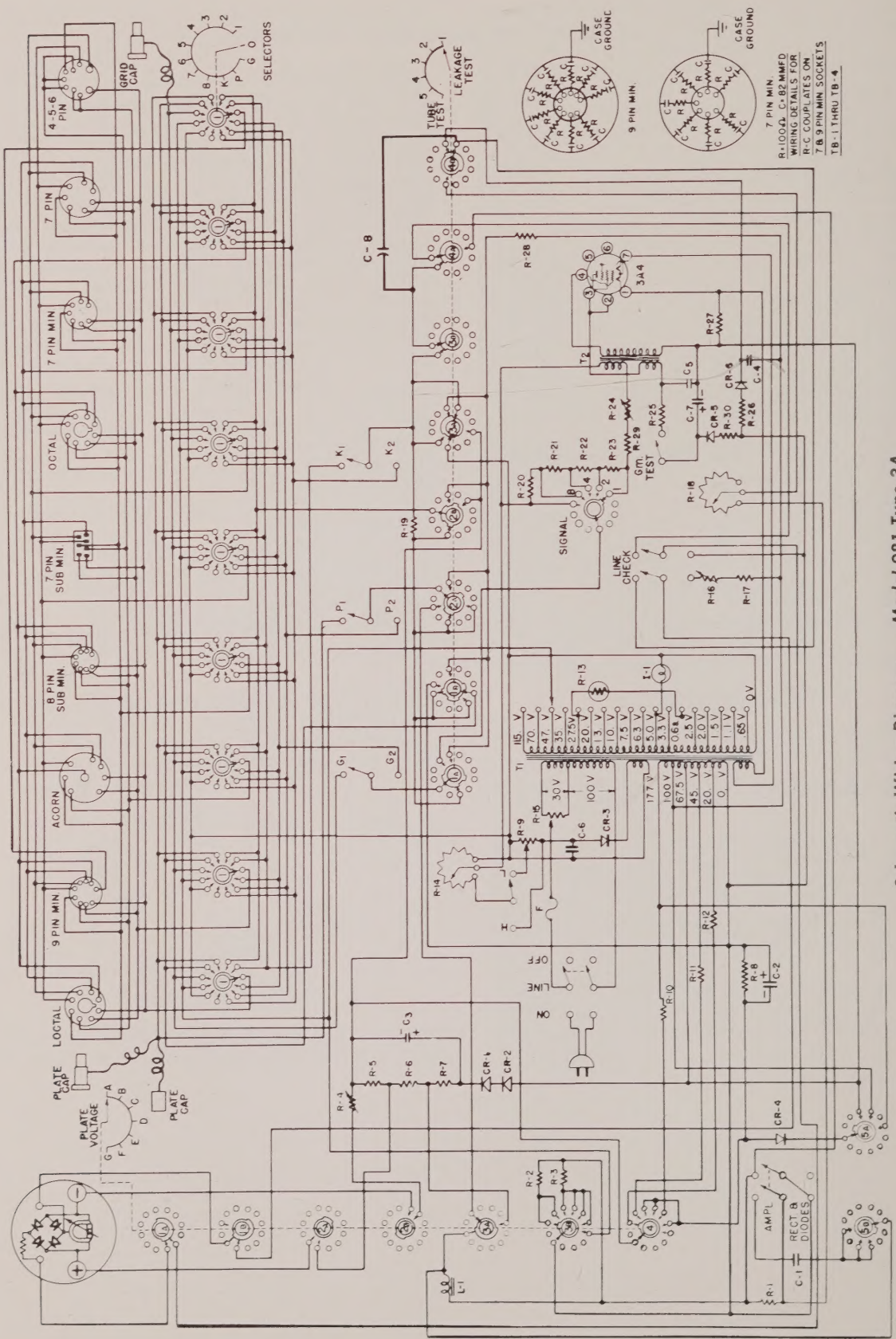
TUBES: A type 3A4 miniature tube is used in the 5000 cycle oscillator circuit. If no meter reading is obtained after several amplifier tubes known to be good have been tested, it is advisable to replace this tube.

An amperite ballast tube, type 5H-12 is used to maintain the constant .6 ampere filament current for series string tubes.

To replace these tubes, remove the 8 panel screws, and lift the complete unit out of its case, and place it face down on a clean flat surface. Both tubes are now accessible.

PARTS LIST FOR MODEL 981 — TYPE 3A

DESCRIPTION	PART NO.
C1—0.1 mfd—400 v	ND-27310
C2—20 mfd—250 v	ND-27944
C3—10 mfd—450 v	ND-27309
C4—0.5 mfd—400 v	ND-27311
C5—.02 mfd—400 v	ND-27312
C6—25 mfd—25 v	ND-27709
C7—Same as C2	
C8—Same as C4	
F1—3AG—2 amp	ND-19566
L1—Inductor	D-118875
I1—#47 Pilot Lamp	ND-20566
R1—3 k Ω ± 1% ½ watt	ND-27300
R2—620 Ω ± 5% ½ watt	ND-24216
R3—100 Ω ± 1% ½ watt	ND-27294
R4—100 Ω Rheostat	ND-27306
R5—1.25 k Ω ± 1% ½ watt	ND-27299
R6—200 k Ω ± 1% 1 watt	ND-27304
R7—2 k Ω ± 10% 10 watt	ND-22116
R8—47 k Ω ± 10% 1 watt	ND-27727
R9—10 k Ω Potentiometer	ND-27940
R10—Same as R7	
R11—2 k Ω ± 5% 1 watt	ND-27314
R12—4.3 k Ω ± 5% 1 watt	ND-24217
R13—Amperite ballast	ND-28431
R14—7.5 k Ω Potentiometer	D-135905
R15—350 Ω Potentiometer	D-135906
R16—15 k Ω Rheostat	ND-27308
R17—185 k Ω ± 1% ½ watt	ND-27303
R18—Same as R14	
R19—2.7 k Ω ± 10% ½ watt	ND-21056
R20—250 Ω ± 1% ½ watt	ND-27295
R21—Same as R20	
R22—500 Ω ± 1% ½ watt	ND-27297
R23—1 k Ω ± 1% ½ watt	ND-27298
R24—4 k Ω Rheostat	D-153014
R25—10 k Ω ± 1% ½ watt	ND-27301
R26—1.8 k Ω ± 10% ½ watt	ND-21091
R27—3 k Ω ± 5% 1 watt	ND-23670
R28—127 k Ω ± 1% ½ watt	ND-27302
R29—7.5 k Ω ± 1% ½ watt	ND-27331
R30—47 Ω ± 10% ½ watt	ND-27615
T1—Power Transformer	D-146886
T2—Reactor	D-146877
CR1—Selenium Rect. 65 ma	ND-34719
CR2—Same as CR1	
CR3—GE-IN91 Rect.	ND-27844
CR4—GE-IN158 Rect.	ND-27941
CR5—Selenium Rect.	ND-26778
CR6—Same as CR5	
TB1—Couplate, RC	D-158501
TB2—Same as TB1	
TB3—Same as TB1	
TB4—Same as TB1	
V-1—3A4 Vacuum Tube	ND-23645



Schematic Wiring Diagram — Model 981 Type 3A

TUBE TYPE	FIL	SIG	BIAS	SELECTORS	SENS	Ep	REJ. PT.	REMARKS
01A	5	2	22H	63500-7000	42	D	520	F.
1A4	2	1	30L	63400-7000	39	C	490	Grid cap; F.
1A5	1.5	2	40L	06345-0700	43	C	550	F.
1A6	2	1	30L	73454-6000	36	C	350	Grid cap; F; whole tube.
1AB5	1.1	1	17L	63400-5700	29	D	880	F.
1B4	2	2	30L	63400-7000	40	C	420	F.
1B5/25S	2	2	30L	73005-6000	46	D	370	F.
	2	D	—	703P0-6000	45	A	—	F.
1B7	1.5	2	10L	07345-4600	42	C	1000	Grid cap; F; whole tube.
1C6	2	1	20L	73454-6000	37	C	750	F; whole tube.
1C7	2	1	10L	07345-4600	38	C	750	Grid cap; F; whole tube.
1D5	2	1	31L	26340-0700	25	C	490	Grid cap; F.
1D7	2	1	15H	07345-4600	39	C	650	Grid cap; F; whole tube.
1E4	1.5	2	31L	06305-0700	38	C	490	F.
1E5	2	2	31L	06340-0700	40	D	420	Grid cap; F.
1E7	2	4	45L	06355-3740	42	D	930	F; X2.
1F4	2	2	15H	63504-7000	42	D	1100	F.
1F6	2	2	20L	63400-7000	43	C	420	F.
	2	D	—	6003P-7000	48	A	—	F; P_1 & P_2
1F7	2	2	20L	06300-4700	43	C	420	F.
	2	D	—	0603P-0700	48	A	—	F; P_1 & P_2.
1G4	1.5	2	15H	07305-0600	42	C	540	F.
1G5	2	2	34H	06345-0700	42	D	1000	F.
1H6	2	1	30L	07300-5600	35	D	370	F.
	2	D	—	0703P-0600	48	A	—	F.
1J5	2	2	41H	06345-0700	43	D	620	F.
1J6	2	2	0	0735G-P600	43	D	850	F; P_1 G_1 & P_2 G_2
1N6	1.5	2	43L	26345-0700	43	C	520	F.
	1.5	D	—	06000-3700	48	A	—	F.
1P5	1.5	2	0	26340-0700	41	C	500	Grid cap; F.
1SA6	1.5	2	0	06250-4730	40	C	630	F.
1SB6	1.5	2	0	06340-0750	41	C	440	F.
	1.5	D	—	06003-0700	48	A	—	F.
2A6	2.5	1	19L	73001-6000	38	F	720	Grid cap.
	2.5	D	—	703P1-6000	48	A	—	P_1 & P_2
2A7	2.5	1	27L	73445-1600	30	C	750	Grid cap; whole tube.
2B7	2.5	2	30L	73400-1600	44	D	730	Grid cap.
	2.5	D	—	7003P-1600	46	A	—	P_1 & P_2
5X3	5	R	—	73P00-6000	24	E	—	F; P_1 & P_2
6A4	6.3	1	30H	73504-6000	33	D	1430	F.
6AD5	6.3	1	19L	07305-0610	42	F	1050	
6AD6	6.3	E	H	27553-0610	—	E	—	Bias must vary shadow.
6AE5	6.3	1	38H	27305-0610	42	C	780	
6AE6	6.3	2	15L	073P5-0610	44	F	650	P_1 & P_2
6AF5	6.3	1	38H	07305-0610	46	D	980	
6AK7	6.3	8	30L	271G1-4630	36	D	1190	G_1 & G_2; X6.
6B5	6.3	2	0	73451-6000	35	F	780	X2.
6B6	6.3	1	20L	07300-0610	39	F	720	Grid cap.
	6.3	D	—	0703P-0610	45	A	—	P_1 & P_2
6B7	6.3	2	30L	73400-1600	44	D	730	Grid cap.
	6.3	D	—	7003P-1600	46	A	—	P_1 & P_2
6C6	6.3	1	30L	73421-6000	38	C	800	Grid cap.
6C7	6.3	2	23H	73000-1600	46	F	810	Grid cap.
	6.3	D	—	7003P-1600	48	A	—	P_1 & P_2
6D7	6.3	1	30L	73420-1600	39	C	800	Grid cap.
6D8	6.3	2	20L	07345-4610	39	C	750	Grid cap; whole tube.
6E6	6.3	1	46H	7351G-P600	47	D	1100	P_1 G_1 & P_2 G_2
6F5	6.3	1	20L	27030-0610	37	F	980	Grid cap.
6H4	6.3	D	—	07030-0610	39	A	—	
6K5	6.3	1	30L	27300-0610	40	F	910	Grid cap.
6N6	6.3	2	0	07345-0610	35	F	780	X2.
6P7	6.3	1	30L	27634-0010	32	C	720	Grid cap; Pe.
	6.3	1	30L	27600-3510	36	C	330	Cap off; Tr.
6Q5	6.3	R	—	27305-0610	26	E	—	Thyra; Five 35-5 bias.

TUBE TYPE	FIL	SIG	BIAS	SELECTORS	SENS	Ep	REJ. PT.	REMARKS
6Q6	6.3	1	30L	07300-0610	45	F	680	Grid cap.
	6.3	D	—	07003-0610	48	A	—	
6R7	6.3	2	23H	27300-0610	46	F	1240	Grid cap.
6SZ7	6.3	1	30L	25100-3760	41	F	780	
	6.3	D	—	2013P-0760	48	A	—	P_1 & P_2
6T5	6.3	E	H	75531-6000	—	E	—	Bias must vary shadow.
6T7	6.3	1	31L	27300-0610	39	F	680	Grid cap.
	6.3	D	—	2703P-0610	48	A	—	P_1 & P_2
6V5	6.3	4	30H	00345-0670	44	F	1220	X2.
6V7	6.3	1	45H	27300-0610	31	F	710	Grid cap.
	6.3	D	—	2703P-0610	48	A	—	P_1 & P_2
6W5	6.3	R	—	0730P-0610	25	E	—	P_1 & P_2
6W7	6.3	1	31L	07342-0610	38	C	700	Grid cap.
6Y5	6.3	R	—	7231P-6000	25	E	—	P_1 & P_2
6Y7	6.3	4	0	0735G-P610	44	F	980	P_1 G_1 & P_2 G_2; X2.
6Z5	6.3	R	—	7631P-6000	24	E	—	P_1 & P_2
6Z7	6.3	4	0	0735G-P610	45	D	810	P_1 G_1 & P_2 G_2; X2.
10	7.5	2	43H	73500-6000	35	F	1050	F.
12A	5	2	24H	73500-6000	44	D	1100	F.
12A5	6.3	4	46H	63451-7600	46	D	780	X2.
12A7	13	2	31H	73400-1600	43	D	630	Grid cap.
	13	D	—	70013-0600	36	A	—	
12B7	13	2	29L	73421-5160	44	C	1350	
12B8	13	2	28L	17340-0600	42	C	1170	Grid cap; Pe.
	13	4	0	07003-1650	43	C	780	Cap. off; Tr; X2.
12E5	13	2	29H	27305-0610	43	F	950	
12F5	13	1	20L	27030-0610	37	F	980	Grid cap.
12L8	13	2	20H	51GP4-7630	43	D	910	P_1 G_1 & P_2 G_2; X3.
12SX7	13	4	20H	531GP-K760	45	F	850	P_1 G_1 K_1 & P_2 G_2 K_2; X2.
12Z3	13	R	—	73100-6000	25	E	—	
19	2	2	0	735GP-6000	43	D	880	F; P_1 G_1 & P_2 G_2
22	3.3	1	15L	73400-6000	46	C	350	F; Grid cap.
24A	2.5	1	30L	73401-6000	43	C	700	Grid cap.
25A6	27.5	2	43H	27345-0610	41	C	770	
25A7	27.5	2	37H	07345-0610	45	C	1170	
	27.5	R	—	17000-3600	25	E	—	
25B5	27.5	4	0	73451-6000	45	C	750	X2.
25B6	27.5	4	49H	27345-0610	37	D	1080	X3.
25B8	27.5	2	30L	17340-0600	44	C	1300	Grid cap; Pe.
	27.5	2	10L	07003-1650	47	C	980	Cap off; Tr.
25N6	27.5	4	0	07345-0610	44	C	750	X2.
25X6	27.5	R	—	2731P-06K0	26	E	—	P_1 K_1 & P_2 K_2.
25Y5	27.5	R	—	731KP-6000	26	E	—	P_1 K_1 & P_2 K_2
25Z4	27.5	R	—	07003-0610	24	E	—	
26	1.5	2	23H	73500-6000	44	D	750	F.
27	2.5	2	40H	73501-6000	42	F	650	
28Z5	6.3	R	—	70300-P160	27	E	—	P_1 & P_2
30	2	2	23H	73500-6000	44	D	580	F.
31	2	2	35H	73500-6000	45	D	650	F.
32	2	2	15L	73400-6000	48	C	450	F; Grid cap.
33	2	2	32H	63504-7000	44	D	1100	F.
34	2	2	15L	63400-7000	42	C	—	F; Grid cap.
35/51	2.5	1	30L	73401-6000	44	C	670	Grid cap.
35Z6	35	R	—	0731P-06K0	23	E	—	P_1 K_1 & P_2 K_2.
36	6.3	1	30L	73401-6000	42	C	700	Grid cap.
37	6.3	2	35H	73501-6000	42	F	710	
38	6.3	2	45H	73401-6000	42	F	800	Grid cap.
39/44	6.3	2	30L	73401-6000	45	C	700	Grid cap.
40	5	1	30L	73500-6000	42	D	400	F; X ½.
43	27.5	4	40H	73451-6000	42	D	770	X ½.
45	2.5	2	49H	73500-6000	37	F	770	F; X2.
47	2.5	1	41H	73504-6000	41	D	820	F; X2.
48	27.5	2	40H	73451-6000	35	C	1230	X2.
49	2	2	40H	73504-6000	42	D	750	F.

TUBE TYPE	FIL	SIG	BIAS	SELECTORS	SENS	Ep	REJ. PT.	REMARKS
50	7.5	1	40H	73500-6000	38	D	1250	F.
53	2.5	2	13H	7351G-P600	44	F	1050	P_1 G_1 & P_2 G_2
55	2.5	2	30L	73001-6000	38	F	710	Grid cap.
	2.5	D	—	703P1-6000	45	A	—	P_1 & P_2
56	2.5	2	27H	73501-6000	38	F	950	
57	2.5	2	30L	73421-6000	44	D	800	Grid cap.
58	2.5	2	30L	73421-6000	45	C	1050	Grid cap.
59	2.5	2	40H	73452-1600	45	F	800	X2.
70A7	70	4	18H	07345-0610	39	C	1250	X3.
	70	R	—	10000-3700	33	A	—	Leak on 1 & 3.
71A	5	1	49H	73500-6000	35	D	1100	F.
75	6.3	1	20L	73001-6000	37	F	720	Grid cap.
	6.3	D	—	703P1-6000	48	A	—	
76	6.3	2	33H	73501-6000	47	F	950	
77	6.3	2	28L	73421-6000	38	D	750	Grid cap.
78	6.3	2	28L	73421-6000	42	D	1100	Grid cap.
79	6.3	2	20L	7351P-6000	37	F	820	Grid cap; P_1 & P_2; X2.
85	6.3	2	30L	73001-6000	38	F	710	Grid cap.
89	6.3	2	40H	73421-6000	42	F	1150	Grid cap.
950	2	2	41H	63504-7000	43	D	620	F.
FM1000	6.3	4	29L	75134-5160	43	D	650	
1221	6.3	1	25L	5731G-KP60	39	C	970	K_1 P_1 & K_2 P_2
1223	6.3	1	30L	07342-0610	38	C	800	Grid cap.
1284	13	2	29L	73420-5160	44	C	1350	
1293	1.5	2	0	63000-5070	43	C	840	F.

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